

B1 Appln. No. 09/508,322

- 2 -

May 12, 2000

units of copper to 1 unit of the [one or more] hard carbide forming metals.

REMARKS

The above amendments are made to conform the application to the amendments made prior to the international preliminary examination. The International Preliminary Examination Report dated November 16, 1999 is enclosed.

Respectfully submitted,

SYNNESTVEDT & LECHNER LLP

By:



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Enclosure

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From the  
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

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NOTIFICATION OF TRANSMITTAL OF  
THE INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT

(PCT Rule 71.1)

Date of mailing  
(day/month/year)

16.11.99

Applicant's or agent's file reference  
TNT 2621

IMPORTANT NOTIFICATION

International application No  
PCT/GB98/02526

International filing date (day/month/year)  
21/08/1998

Priority date (day/month/year)  
09/08/1997

Applicant

FEDERAL-MOGUL TECHNOLOGY LIMITED et al.

Re: your letter dated 21.02.2000.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

Enclosed please find copy of IPR which was sent on 16.11.1999.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/



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## PATENT COOPERATION TREATY

## PCT

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference <b>TNT 2621</b>	<b>FOR FURTHER ACTION</b>		See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/418)
International application No. <b>PCT/GB98/02526</b>	International filing date (day/month/year) <b>21/08/1998</b>	Priority date (day/month/year) <b>09/09/1997</b>	
International Patent Classification (IPC) or national classification and IPC <b>C22C37/00</b>			
Applicant <b>FEDERAL-MOGUL TECHNOLOGY LIMITED et al.</b>			

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 38.


2. This REPORT consists of a total of 5 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 2 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand <b>11/03/1999</b>	Date of completion of this report <b>16.11.99</b>
Name and mailing address of the international preliminary examining authority:  <b>European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523658 epmu d Fax: +49 89 2399 - 4465</b>	Authorized officer <b>Badcock, G</b> Telephone No. +49 89 2399 8445

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# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB98/02526

## I. Basis of the report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

### Description, pages:

1,3-6	as originally filed		
2	as received on	08/10/1999	with letter of 06/01/1999

### Claims, No.:

7	as originally filed		
1-6	as received on	08/10/1999	with letter of 06/01/1999

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:  
☐ the claims, Nos.:  
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

## V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

### 1. Statement

Novelty (N)	Yes: Claims 1-7
	No: Claims
Inventive step (IS)	Yes: Claims
	No: Claims 1-7
Industrial applicability (IA)	Yes: Claims 1-7
	No: Claims

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EXAMINATION REPORT**International application No. PCT/GB98/02526

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**2. Citations and explanations****see separate sheet****VIII. Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

**see separate sheet**

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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**1. Amendments Art.34(2b)**

The amended claims and page 2 of the description are considered to be based upon subject matter which was disclosed in the originally filed documents.

**2. Clarity. Art.6 PCT**

- 2.1. The phrase "carbide forming metals.." in claim 1 is unclear. It neither gives an indication as to which metals could be considered as carbide forming, nor does the description give any indication as to the propensity of a metal to form a carbide. This will depend upon many factors other than the metals present, such as the carbon content and the cooling rate from the melt.

The objection could be overcome by listing the carbide forming metals, excluding vanadium and titanium, as tungsten, chromium, molybdenum and niobium. Claim 2 is in this respect not limiting since it refers to the phrase "also including". An allowable phrase would be to replace it with "consisting".

- 2.2. It would also appear from the description that the feature of "the vanadium must be equal or less than half the copper added to twenty times the titanium content" is essential to the invention, in particular in achieving the wear resistance of the rotor, (cf. page 3, middle and page 4, penultimate paragraph). The omission of this apparently essential feature results in a lack of clarity to the extent that the aims of the invention may not be achieved.

**3. Novelty. Art.33(2)**

None of the documents cited in the International Search Report discloses a disc brake rotor with the compositional limitations given in claim 1. The disc brake rotor of claim 1 is novel.

The closest prior art is considered to be JP-A-2 138 438 which discloses rotors for disc brakes with good wear properties, high strength, good damping properties and good resistance to thermal cracking. The rotor is made of grey cast iron containing 0.20-2.0 wt.% Cu, 0.05-1.0 wt.% Cr, 0.4-1.2 wt.% Mo, 0.05-0.10 wt.% Ti and 0.02-0.35 wt.% V. A compositional overlap with the claimed composition is, therefore, very narrow. None of the exemplified steels in the patent document discloses a steel falling within the claimed range. The claimed compositional

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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limitation alleges an improvement in the thermal fatigue and wear resistance.  
Hence the claimed rotor composition must be considered a novel selection.

**4. Inventive step. Art. 33(3)**

The selection of a brake rotor comprising a grey cast iron with the compositional limitations of claim 1 convincingly solves the problem of wear resistance and thermal fatigue, assuming that the term "hard carbide forming metals" consists of at least one of the group of tungsten, chromium, molybdenum and niobium as well as both of titanium and vanadium (see item 2 above). The solution provided is not considered obvious for the skilled man. Without such a limitation however, it would not be possible to foresee whether the aims of the invention could be achieved.

**5. Industrial applicability. Art. 33(4)**

The subject matter of the claims is deemed industrially applicable.

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0.2-0.8 wt% niobium and 0.3-0.5 wt% copper. However, alloying has a detrimental effect on thermal conductivity.

In addition to thermal and mechanical considerations, a material for a disc brake rotor must exhibit good wear resistance. In an unalloyed iron, wear resistance is primarily a function of the matrix structure and its hardness. Alloying the iron can create carbides so that wear resistance becomes more a function of the properties of the carbides. However, when vanadium, titanium and chromium are added to iron in excess quantities, a fall in the strength occurs arising from the formation of intergranular carbides in the matrix. Carbide stabilising elements such as chromium, molybdenum and vanadium also increase the tendency for the formation of free ferrite which is detrimental to the strength and tribological properties. For this reason, these elements are normally used at levels which are below those at which free carbides are formed so that the wear benefits of free carbides are not obtained. It is also considered that the use of high alloy structures containing free carbides would cause the formation of "hot spots" resulting in brake judder and heat cracking.

The present invention has the object of further increasing the thermal fatigue and wear resistance properties of a disc brake rotor.

The invention provides a disc brake rotor having a grey cast iron composition, characterised in that said composition comprises between 0.5 and 1.2% by weight of copper, and a plurality of hard carbide forming metals including both vanadium and titanium, the ratio between the weight of copper present and the total weight of said hard carbide forming metals being 1.8 to 3 units of copper to 1 unit of the hard carbide forming metals.

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## CLAIMS

- 1 A disc brake rotor having a grey cast iron composition, characterised in that said composition comprises between 0.5 and 1.2% by weight of copper, and a plurality of hard carbide forming metals including both vanadium and titanium, the ratio between the weight of copper present and the total weight of said hard carbide forming metals being 1.8 to 3 units of copper to 1 unit of the hard carbide forming metals.
- 2 A disc brake rotor according to claim 1, characterised in that the hard carbide forming metals also include one or more of tungsten, molybdenum, chromium, and niobium.
- 3 A disc brake rotor according to either one of claims 1 and 2, characterised in that the weight of vanadium present in the composition is less than or equal to one half of the weight of copper present added to 20 times the weight of titanium present.
- 4 A disc brake rotor according to any one of claims 1 to 3, characterised in that the carbon equivalent of the composition is between 4.2 and 4.55.
- 5 A disc brake rotor according to any one of claims 1 to 4, characterised in that the titanium content of the composition is between 0.025 and 0.035 wt%.
- 6 A disc brake rotor according to any one of claims 1 to 5, characterised in that the vanadium content of the composition is between 0.35 and 0.45 wt%.

AMENDED SHEET

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